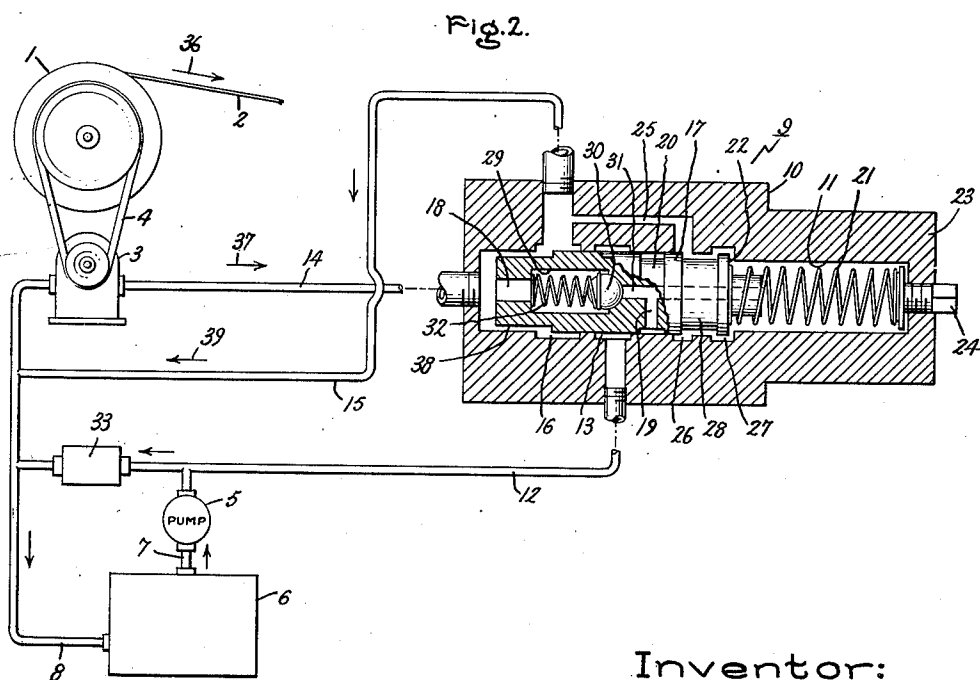
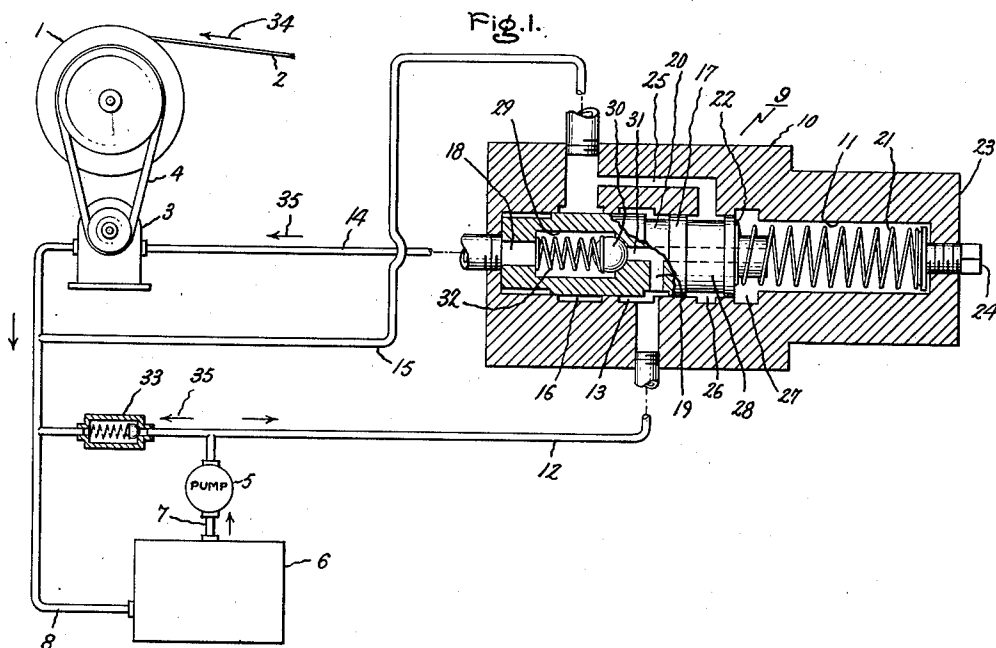


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CABLE REELING SYSTEM

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CABLE REELING SYSTEM

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This invention relates to cable reeling systems and more particularly to hydraulically-operated systems for use on mine vehicles such as gathering locomotives and shuttle cars.

Mine locomotives of the gathering type and mine shuttle cars are conventionally supplied with electric power by means of an electric cable wound on a reel mounted on the vehicle. These cable reels have been electrically driven, however, it has been found more desirable to provide a hydraulic motor drive. In the design of such hydraulically-operated cable reeling systems, it is desirable to maintain constant tension on the cable during both reeling-in and paying-off, however, this tension must not be sufficient to cause damage to the cable. It is further desirable to provide a system which will automatically switch from reeling-in to paying-out whenever the vehicle is reversed and from paying-out to reeling-in whenever the vehicle is stopped.

An object of this invention therefore is to provide an improved cable reeling system incorporating the desirable features set forth above.

Further objects and advantages of this invention will become apparent and the invention will be better understood by reference to the following description and the accompanying drawings, and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In accordance with this invention, there is provided a cable reel adapted to have an electric cable wound thereon and a hydraulic motor connected to drive the reel for reeling-in the cable and to be driven by the reel as a pump when the cable is being reeled-out. A hydraulic pump is provided for supplying fluid to the hydraulic motor with a pressure line connecting the motor and the pump and a discharge line connecting the motor and a fluid reservoir. A pilot valve is arranged in the pressure line and another discharge line connects the valve and the first discharge line. The valve is normally biased so that the pressure line from the pump to the motor is open and the discharge line is closed. The valve is operable in response to fluid pressure created by the motor when driven as a pump to close the pressure line, isolating the pump from the motor, and to open the second discharge line, thus connecting the motor in a loop back to the first discharge line. Thus, during the reeling-in operation, the pump supplies fluid to the motor through the pressure line and the normally open valve. However, when the direction of reeling is reversed, the reel motor is driven as a pump, creating fluid pressure which operates the valve to close the pressure line and open the second discharge line. Thus, the motor circulates fluid through the valve, the spring bias providing a back pressure on the motor, so that tension is maintained on the cable. When the reeling-out of the cable ceases, and the reel and reel motor are at a standstill, there will be no fluid pressure on the valve from the motor and the biasing means in the valve will again operate the valve to open the pressure line and close the second discharge line. Thus,

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the motor automatically starts to reel in responsive to a standstill condition of the reel.

In the drawing, Fig. 1 is a schematic view showing the improved cable reeling system of this invention in the reeling-in condition; and Fig. 2 is a similar view showing the system in the reeling-out condition, both figures showing a side elevational view of the pressure-actuated valve, partly in section.

Referring now to Fig. 1, there is shown a cable reel 1 connected to have an electric cable 2 wound thereon. A hydraulic motor 3 of any suitable type is provided for driving the cable reel 1, as by a belt connection 4. A hydraulic pump 5 is provided driven in any suitable manner (not shown) for supplying fluid to the motor 3. A fluid reservoir 6 is provided connected to pump 5 by a line 7 and to hydraulic motor 3 by a discharge line 8.

A pressure-actuated pilot valve 9 is provided having a valve body 10 with a cavity 11 formed therein. A pressure line 12 connects the hydraulic pump 5 to the valve body cavity 11, communicating with an annular groove 13 formed in the wall of the cavity 11. Another pressure line 14 connects the hydraulic motor 3 to one end of the cavity 11. Another discharge line 15 connects the cavity 11 to the line 8, communicating with an annular groove 16 formed in the wall of the cavity 11. An internal spool 17 is arranged within the cavity 11 and has an axially extending passage 18 formed therein. A radially extending passage 19 communicates with the rear portion 31 of axial passage 18 and an annular groove 20 formed on the outer periphery of the spool 17. A spring 21 is arranged in the cavity 11 between the end 22 of the spool 17 and the rear wall 23 of the valve body 10, the pressure applied by the spring being adjusted by a suitable adjusting screw 24. A passage 25 formed in the valve body 10 communicates with the second discharge line 15 and an annular groove 26 formed in the wall of the cavity 11. Another annular groove 27 is formed in the wall of the cavity 11 rearwardly from the groove 26, and an annular groove 28 is formed in the outer periphery of the spool 17 and rearwardly from the annular groove 20. The axial passage 18 is provided with an enlarged portion 29 in which a ball check valve is arranged. The ball check valve comprises a ball 30 seated against the entrance of the rear portion 31 of the axial passage 18 under the influence of spring 32. A suitable pressure relief valve 33 is arranged between the pressure line 12 and the line 8.

It will be seen that the spring 21 of valve 9 normally biases the spool 17 into the position shown in Fig. 1. In this position, annular groove 13 to which pressure line 12 is connected, communicates with annular groove 20 of spool 17, and thus with radial passage 19 and axial passage 18, which in turn communicates with pressure line 14. In the reeling-in operation, as shown in Fig. 1, the cable 2 is moving in the direction shown by the arrow 34, and the spring 21 has biased the spool 17 to the position shown, and with pressure line 12 communicating with pressure line 14 and second discharge line 15 being closed. It will be readily seen that the check valve comprising ball 30 and spring 32 in the enlarged portion 29 of axial passage 18 permits the flow of fluid from the pressure line 12 to the pressure line 14, but prevents flow in the reverse direction. Thus, the pump 5 draws fluid from the reservoir 6 through line 7 and fluid flows under the influence of the pump 5 through pressure line 12, annular grooves 13 and 20, passages 19 and 31, past the ball check valve, and through the pressure line 14 to the motor 3, the motor discharging fluid to the reservoir 6 through the first discharge line 8. Uniform pressure in the system is provided by pressure relief valve 33. Here, the direction of fluid flow is shown by the arrows 35.

Referring now to Fig. 2, in which like parts are indicated by like reference numerals, the cable 2 is shown as reeling-out in the direction shown by the arrow 36. The

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motor 3 is thus reversed due to the pull on the cable reel 1, making the motor act as a pump. Pressure will thus be created in the pressure line 14 by the motor 3 in the reverse sense from the pressure previously appearing therein, with the motor 3 tending to pump fluid back through the line 14 in the direction shown by the arrow 37. It will be readily seen that fluid cannot pass around the ball check valve 30—32 in the direction 37, and this pressure will therefore force the spool 17 rearwardly in the cavity 11 against the force of the spring 21. This rearward movement of the spool 17 closes annular groove 13 and thus pressure line 12, so that pump 5 no longer supplies fluid to the motor 3 but rather pumps its entire output through the pressure relief valve 33. This system is generally termed a closed center system, which means that it is a constant pressure system with a constant pressure from the pump in line 12. Such a constant pressure system has a distinct advantage in that the hydraulic pressure from the pump 6 may be utilized in other apparatus of this particular device using the cable reel 1. One obvious use is in a hydraulic brake system. Rearward movement of the valve spool 17 exposes reduced section 38 of spool 17 to annular groove 16, thus connecting pressure line 14 to the second discharge line 15. It will thus be seen that fluid pumped by the motor 3 flows through pressure line 14 in the direction shown by the arrow 37 and into the second discharge line 15 in the direction shown by the arrow 39. This fluid then enters first discharge line 8 and returns to motor 3 to be recirculated thereby. It will also be seen that the rearward movement of spool 17 exposes annular groove 28 of the spool 17 to annular grooves 26 and 27, in the wall of the cavity 11, thus causing the passage 25 to communicate with the side 22 of the spool 17 and the rearward portion 31 of the axial passage 18 in the spool 17.

It will be readily seen that back pressure is supplied to the motor 3 when it is driven as a pump, by action of the spring 21 urging the spool 17 forward to restrict the passage communicating with line 15. This back pressure prevents the cable reel from spinning when the vehicle is brought to a sudden stop. When the cable reel 1 slows to a standstill from the reeling-out condition, the pressure in line 14 will bleed off through passage 25, and the spring 21 will return spool 17 to the normal position with the pressure lines 12 and 14 communicating and with the discharge line 15 closed. Thus, the motor 3 is again operable as a motor and will automatically start to operate in the other direction (34) to reel in the cable 2.

It will now be readily apparent that this invention provides a hydraulically operated cable reeling system wherein tension is provided on the cable in both the reeling-in and reeling-out conditions, the tension in the reeling-out condition being merely sufficient to take up the slack in the cable and to prevent spinning of the reel when the vehicle makes a sudden stop, but not sufficient to damage the cable. Furthermore, this system provides for automatically shifting from the reeling-out into the reeling-in position responsive to the cable reel being at a standstill.

While I have illustrated and described a particular embodiment of this invention, further modifications and improvements will occur to those skilled in the art. I desire it to be understood, therefore, that this invention is not limited to the particular embodiment shown, and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of this invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A cable reeling system comprising a cable reel adapted to have a cable wound thereon, a hydraulic motor connected to drive said reel for reeling-in said cable and to be driven by said reel as a pump when said cable is reeled-out for providing a load on said reel so that tension is maintained on said cable, a hydraulic pump for furnishing fluid to said motor, a pressure line connecting said motor and said pump, and valve means arranged in

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said pressure line, said valve means being operable responsive to fluid pressure created by said motor when driven as a pump to close said pressure line isolating said pump from said motor.

2. A cable reeling system comprising a cable reel adapted to have a cable wound thereon, a hydraulic motor connected to drive said reel for reeling-in said cable and to be driven by said reel as a pump when said cable is reeled-out for providing a load on said reel so that tension is maintained on said cable, a hydraulic pump for furnishing fluid to said motor, a pressure line connecting said motor and said pump, valve means arranged in said pressure line and normally biased so that said pressure line is opened, said valve means being operable responsive to fluid pressure created by said motor when driven as a pump to close said pressure line isolating said pump from said motor.

3. A cable reeling system comprising a cable reel adapted to have a cable wound thereon, a hydraulic motor connected to drive said reel for reeling-in said cable and to be driven by said reel as a pump when said cable is reeled-out for providing a load on said reel so that tension is maintained on said cable, a hydraulic pump for furnishing fluid to said motor, a pressure line connecting said motor and said pump, valve means arranged in said pressure line, a discharge line connected to said motor, and a second discharge line connected between said valve means and said discharge line connected to said motor, said valve means being normally biased so that said pressure line is opened and said second discharge line is closed, said valve means being operable responsive to fluid pressure created by said motor when driven as a pump to close said pressure line isolating said pump from said motor and to open said second discharge line so that thereby to connect said motor to said second discharge line through said valve.

4. A cable reeling system comprising a cable reel adapted to have a cable wound thereon, a hydraulic motor connected to drive said reel for reeling-in said cable and to be driven by said reel as a pump when said cable is reeled-out for providing a load on said reel so that tension is maintained on said cable, a hydraulic pump for furnishing fluid to said motor, a pressure line connecting said motor and said pump, a fluid reservoir, a line connecting said pump to said reservoir, another line connecting said motor to said reservoir for discharging fluid from said motor during reeling-in, valve means arranged in said pressure line, a discharge line connecting said valve means and said other line, said valve means being normally biased so that said pressure line is open and said discharge line is closed whereby said pump draws fluid from said reservoir and supplies said fluid to said motor which discharges said fluid to said reservoir through said other line, said valve means being operable responsive to fluid pressure created by said motor when driven as a pump to close said pressure line isolating said pump from said motor and to open said discharge line connecting said motor thereto whereby said motor circulates fluid through said discharge line and said other line.

5. A cable reeling system comprising a cable reel adapted to have a cable wound thereon, a hydraulic motor connected to drive said reel for reeling-in said cable and to be driven by said reel as a pump when said cable is reeled out for providing a load on said reel so that tension is maintained on said cable, a hydraulic pump for furnishing fluid to said motor, a valve having a movable element, a first pressure line connecting said pump and said valve, another pressure line connecting said valve and said motor, a fluid discharge line connected to said valve, spring means normally biasing said valve movable element to connect said pressure lines and close said discharge line whereby said pump supplies fluid to said motor, said movable element being arranged to close said first pressure line and to connect said other pressure line to said discharge line responsive to fluid pressure in said other pressure line

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created by said motor when driven as a pump, said spring bias on said valve movable element providing back pressure on said motor when driven as a pump.

6. A cable reeling system comprising a cable reel adapted to have a cable wound thereon, a hydraulic motor connected to drive said reel for reeling-in said cable and to be driven by said reel as a pump when said cable is reeled out for providing a load on said reel so that tension is maintained on said cable, a hydraulic pump for furnishing fluid to said motor, a valve having a movable element with a passage formed therein, a first pressure line connecting said pump and said valve, another pressure line connecting said valve and said motor, a fluid discharge line connected to said valve, spring means normally biasing said valve movable element so that said passage communicates with said pressure lines and said discharge line is closed whereby said pump supplies fluid to said motor, and a check valve arranged in said passage permitting fluid flow only toward said motor whereby fluid pressure in said other pressure line created by said motor when driven as a pump moves said movable element against said spring to connect said other pressure line to said discharge line and to close said first pressure line, said spring bias on said movable element providing back pressure on said motor when driven as a pump.

7. A cable reeling system comprising a cable reel adapted to have a cable wound thereon, a hydraulic motor connected to drive said reel for reeling-in said cable and to be driven by said reel as a pump when said cable is reeled out for providing a load on said reel so that tension is maintained on said cable, a hydraulic pump for furnishing fluid to said motor, a fluid reservoir, a line connecting said pump to said reservoir, another line connecting said motor to said reservoir for discharging fluid from said motor during reeling-in, a valve having a movable element with a passage formed therein, a first pressure line connecting said pump and said valve, another pressure line connecting said valve and said motor, a fluid discharge line connecting said valve and said other line, spring means normally biasing said valve movable element so that said passage communicates with said pressure lines and said discharge line is closed whereby said pump supplies fluid to said motor, and a check valve arranged in said passage permitting fluid to flow only toward said motor whereby fluid pressure in said other pressure line created by said motor when driven as a pump moves said movable element against said spring to connect said other pressure line to said discharge line and to close said first pressure line, said spring bias on said movable element providing back pressure on said motor when driven as a pump.

8. A cable reeling system comprising a cable reel adapted to have a cable wound thereon, a hydraulic motor connected to drive said reel for reeling-in said cable and to be driven by said reel as a pump when said cable is reeled out for providing a load on said reel so that tension is maintained on said cable, a hydraulic pump for furnishing fluid to said motor, a fluid reservoir, a line connecting said pump to said reservoir, another line connecting said motor to said reservoir for discharging fluid from said motor during reeling-in, a valve having a movable element with a passage formed therein, a first pressure line connecting said pump and said valve, another pressure line connecting said valve and said motor, a fluid discharge line connecting said valve and said other line, spring means normally biasing said valve movable element so that said passage communicates with said pressure lines and said discharge line is closed whereby said pump supplies fluid to said motor, and a check valve arranged in said passage permitting fluid to flow only toward said motor whereby fluid pressure in said other pressure line created by said motor when driven as a pump moves said movable element against said spring to connect said other pressure

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line to said discharge line and to close said first pressure line, said spring bias on said movable element providing back pressure on said motor when driven as a pump, and a pressure relief valve connecting said first pressure line and said reservoir thereby to bypass fluid from said pump to said reservoir when said motor is driven as a pump.

9. A cable reeling system comprising a cable reel adapted to have a cable wound thereon, a hydraulic motor connected to drive said reel for reeling-in said cable and to be driven by said reel as a pump when said cable is reeled out for providing a load on said reel so that tension is maintained on said cable, a hydraulic pump for furnishing fluid to said motor, a valve having a body portion with a cavity formed therein, a first pressure line connecting said pump and said valve body cavity, another pressure line connecting said valve body cavity and said motor, a discharge line connected to said valve body cavity, a movable spool arranged in said valve body cavity and having a passage formed therein, a spring in said valve body cavity normally biasing said spool so that said passage communicates with said pressure lines and said discharge line is closed whereby said pump supplies fluid to said motor, and a spring-biased check valve in said passage permitting fluid flow only toward said motor whereby fluid pressure in said other pressure line created by said motor when driven as a pump moves said spool against said spring to connect said other pressure line to said discharge line and to close said first pressure line, said passage communicating with the side of said spool remote from said other pressure line, said valve body having a passage connecting said discharge line and said side of said spool remote from said other pressure line, said last-named passage being closed by said spool in its normal position and opened when said spool is moved responsive to said fluid pressure created by said motor thereby to bleed off pressure in said other pressure line when said motor is stopped after reeling out, said spring bias on said spool providing back pressure on said motor when driven as a pump.

10. A cable reeling system comprising a cable reel adapted to have a cable wound thereon, a hydraulic motor adapted to drive said reel for reeling-in said cable and to be driven by said reel as a pump when said cable is reeled out for maintaining a tension load on said cable, a hydraulic pump for furnishing fluid under pressure to said motor, a valve, a pressure actuated movable element arranged in said valve, a first pressure line connecting said pump to said valve, a second pressure line connecting said motor to said valve, and a check valve arranged in said valve for preventing fluid flow from said second pressure line to said first pressure line, said movable element arranged to connect said first pressure line to said second pressure line in a first position and to close said first pressure line in a second position, said second pressure line being connected to said movable element whereby the pressure created by said motor when driving as a pump moves said element into said second position to close said first pressure line isolating said pump from said motor.

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